Waterway and Wetland Handbook
CHAPTER 90
SURFACE WATER DIVERSION

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A. PURPOSE

The diversion of flow from streams can have an adverse affect on aquatic communities and on downstream beneficial users. Section 30.18, Wis. Stats., was created to preserve the public interest in the waterways as well as the interest of any downstream users.

B. MECHANISM

Section 30.18 requires any riparian to apply for a permit to divert surface water from any navigable or nonnavigable stream for agricultural or irrigation purposes or to maintain the normal flow of any navigable stream, or to bring back or maintain the normal level of any navigable lake. It also requires most persons to obtain permits for diversions from any lake or stream if the diversion will result in a water loss averaging 2,000,000 gallons per day (3.09 cfs) in any 30-day period.

Section 31.02 allows the Department to establish a minimum level on any navigable body of water to protect public rights and interests.

Section 144.855 requires that diversion of surface water for mining purposes requires a permit under s. 30.18.

Section 144.026 requires any person withdrawing more than an average of 100,000 gallons per day (0.15 cfs) in any 30-day period, from any lake or stream, to register with the Department. If the withdrawal results in a water loss averaging more than 5,000,000 gallons per day (7.74 cfs) in any 30-day period from the Great Lakes Basin, the Department must consult with the Governor's Office and with each state and province in the Great Lakes Basin.

C. HISTORY

The legislature adopted the first surface water diversion statute after the state experienced a drought in the early 1930s. Chapter 287, Laws of 1935, created s. 31.14. The original intent of this section was to provide a permit system that would allow for the diversion of surplus water from streams in order to maintain levels and flows of navigable streams and lakes. However, the cranberry growers succeeded in having a provision added requiring authority for diversion of water for agriculture or irrigation purposes.

The first permit to divert surface water was issued in 1949, 14 years after the law was passed. From 1949 through 1959, the Public Service Commission (PSC) established a permit system for irrigation of riparian lands and issued 158 permits.

Chapter 436, Laws of 1957, allowed irrigators to use diverted water on lands contiguous to riparian land. It also included a provision that allowed the commission to reinvestigate irrigation permits and revoke them if it found that such diversions either damaged other riparians or the stream.

Chapter 441, Laws of 1957, contained several small changes but also included two significant alterations. First, s. 31.14 was renumbered to 30.18. Second, it provided for a $1,000 forfeiture for each violation.

In 1959, the court upset the commission's apple cart by ruling in Nekoosa Edwards Paper Co. v. Public Service Commission, 8 Wis. 2d 582 that two of the permits issued by the PSC were invalid. Prior to this case, the PSC assumed that consent of other beneficial users was only required when the PSC determined such users would be damaged by a diversion proposal. The court found that it was not within the jurisdiction of the commission to determine or adjust the rights of riparian owners injured by diversion of nonsurplus water. It further found that the commission's jurisdiction was limited to granting permits for surplus water when the permit was for maintenance of stream flows or lake levels. The commission could grant permits for agriculture and irrigation purposes to divert other than surplus water only with the consent of beneficial users.

Chapter 126, Laws of 1959, prohibited the diversion of water from any trout stream without prior written approval of the conservation commission. At that time the conservation commission and the permitting branch of the PSC were separate. This provision is probably not nearly as significant today as it was in 1959 since both functions are now within the Department. Nonetheless, this portion of the statute remains intact. Chapter 126 also required the commission to review all diversion permits issued since August 1, 1957, and revoke any it found to be detrimental to the stream or other riparians and required the PSC to revoke a permit for diversion from a trout stream if the conservation commission requested it for conservation purposes.

In 1961, Chapter 366 changed the penalty section from civil to criminal by adding a 6-month jail sentence and changing the forfeiture to a fine.

The Laws of 1963, 1965 and 1969 made minor editorial changes and shifted the administration from the Public Service Commission to the Department. Until 1963, the "contiguous land amendment" of 1957 was renewed biannually. The 1963 amendment made this provision permanent.

Chapter 200, Laws of 1965, authorized game wardens to enforce the penalties provided in s. 30.18. Prior to this time, program staff registered complaints.

Typically, most activity under this statute occurs during extended drought conditions. Such a period occurred in 1977, when the Department issued an emergency rule (NR 350) and the Governor's Office declared a temporary suspension of the notice requirements of s. 30.18 and allowed for applicants to go directly to hearings. In 1988, the Governor also temporarily suspended the notice requirements, and the legislature further extended the suspension. Future drought conditions will likely bring similar emergency

actions into play.

1985 Wisconsin Act 60 modified s.30.18 and s.144.026, as well as several other sections of the statutes. It required registration of withdrawals averaging more than 100,000 gallons per day (0.15 cfs) in any 30-day period, permits for losses averaging 2,000,000 gallons per day (3.09 cfs) in any 30-day period, and made several procedural changes in s.30.18.

1987 Wisconsin Act 374 (Ch. 30 rewrite bill) made some minor procedural changes to reflect current practice, but also decriminalized violation and required a review of permits at least every five years (formerly, an annual review was required).

In 1989, the legislature adopted Act 31 which included a definition of agriculture. This definition, presently in s.30.40(1), is our current definition of agriculture for chapter 30.

Several other acts over the years made minor changes to the statute.

D. STANDARDS

1. STATUTORY

a. Section 30.18 provides that:

1) Diversions permits can only be granted to owners of riparian land.

2) The diversion shall not injure public rights in the stream.

3) If other than surplus water is diverted, the diversion shall not injure any riparians without their consent.

4) Diversions for one of the following purposes require a permit:
   a) Maintaining the normal flow of any navigable stream.
   b) Bringing back or maintaining the normal level of any navigable lake.
   c) Agriculture or irrigation.

5) An application for a permit to divert water must contain the following:
   a) Name and address of the applicant.
   b) Name of the stream.
   c) The point on the stream from which the water will be taken.
   d) The name of the lake or stream, or description of lands to which the water is to be diverted.
   e) A description of the equipment involved.
   f) The amount and time periods of the diversion.
   g) Schedule for completion of necessary construction.
   h) Four sets of plans showing cross-sections and profiles of the diversion works and any dam or control works at the points of diversion and discharge.

6) Diversion applications for the purpose of maintaining normal levels of a navigable lake or normal flows of a navigable stream shall include a map on a scale of not less than 1 inch per 2,000 feet.

7) All diversion proposals shall be noticed pursuant to the procedures of s. 30.02.

8) The notice and hearing requirements of s. 30.18 supersede those of s. 144.836 when both apply.

9) Diversion from a designated trout stream in the Department's publication 6-3600 requires prior written approval from the Department.

10) The Department shall fix the amount of water to be diverted and when such water may be diverted.

11) Diverters may not withdraw more water than they did prior to 1957.

12) Diverted water may be used on contiguous land.

13) The Department may revoke a diversion permit on a trout stream if it finds the diversion is not in the interest of conservation.

14) The applicant may enter any land through which it is proposed to divert water, for purposes of preparing plans.

15) After the permit has been granted the permittee may construct diversion works on the lands of others, but only after damages have been paid to the owners and the plans have been approved by the Department.

16) If funds are available, the Department may, for conservation purposes, fix and raise the level of any navigable stream or lake. However, no lands may be flowed before the right to flow such lands has been secured.

17) The Department may not fix the level of any navigable stream or lake below the normal elevation.

b. Section 30.21 provides that any municipality or public utility situated on any waters of Lake Michigan or Lake Superior or in the Great Lakes Basin may, without a DNR permit, construct on the beds of such waters all cribs, intakes, basins, pipes and tunnels necessary or convenient for securing an adequate supply or water for the purposes of such utility provided adequate sewage treatment and disposal works for all the municipal sewage treatment needs are constructed. Public utilities also may improve the navigability and construct harbor facilities on such waters necessary for their operation.

c. Section 31.02 provides that the Department may, by order, fix a level for any navigable body of water below which it may not be lowered except as provided in Chapter 31. This statute allows the Department to restrict the diversion from lakes and ponds not normally covered under s. 30.18.

d. Section 86.17 provides that:

1) The general public has the right to use and take water from any spring, creek or running water that is running in or across the limits of any public highway.

2) The general public's use of such water may not interfere with the tunneling or piping of water for purposes of draining or improving adjacent land.

3) Any person interfering with the public's right to use such water is guilty of a misdemeanor.

e. Section 88.93 provides that:

1) An owner of land within a drainage district, whose land borders the drainage ditch, may take water from the ditch for purposes of flooding cranberry cultures or irrigation.

2) Diversions under this statute may not defeat the purposes of the drainage district.

3) Diversion under this statute for irrigation for other than cranberries also requires a permit under s. 30.18.

f. Section 94.26 provides that any cranberry grower may construct dams across any watercourse or ditch for the purposes of irrigating lands owned by the grower, provided the damming does not injure other lawfully constructed dams or ditches.

g. Section 144.026 requires:

1) Registration of diversions averaging greater than 100,000 gallons per day (0.15 cfs) in any 30 day period.

2) Permits for water losses averaging greater than 2,000,000 gallons per day (3.09 cfs) in any 30 day period.

3) Diversions from the Great Lakes Basin greater than 5,000,000 gallons per day (7.74 cfs) in any 30 day period require consultation with the other Great Lakes states and Canadian provinces.

h. Section 144.855 provides that diversion of surface water for mining purposes requires a permit from the Department under s. 30.18. Procedures under this statute shall be the same as those in s. 30.18 to the extent practicable. The standards involved in s. 144.855 are different from the standards of s. 30.18. The standards of this section should be reviewed in detail before a permit is issued.

2. ADMINISTRATIVE

a. NR 103 establishes water quality standards to be applied by the Department in decisions affecting wetlands. NR 103 further specifies the requirements to be used by the Department when determining the potential adverse effects of a project on a wetland versus the benefit to the applicant.

b. NR 104 establishes water quality standards that must be considered during Department permit procedures. Diversion permits must reflect the minimum flow required for pollutant discharges specified in the Wisconsin Pollutant Discharge Elimination System (WPDES) permit.

c. NR 150 establishes procedures for determining whether a given project requires an Environmental Impact Statement (EIS). Diversion for maintenance of levels and flow are considered type II actions (requires an Environmental Analysis) while diversion for irrigation or agricultural purposes are considered type IV actions (do not normally require Environmental Analysis).

d. NR 210 establishes discharge limitations for discharges of pollutants into streams within the state. These limitations are predicted on maintaining minimum water quality standards and dilution at the 7-day, 10-year low flow discharge point.

3. ADMINISTRATIVE INTERPRETATIONS

a. Attorney General's Opinions:

A December 12, 1950, Attorney General's Opinion 39 OAG 564-568 clarified several matters. It

stated that:

1) A mere reduction in flow past any point in the stream did not necessarily injure the rights of the public or other riparians. Instead injury must be determined by the facts of the case.

2) Riparians whose water needs require consideration are those located along the stream below the proposed diversion to the point where it flows into a larger stream and loses its identity. This interpretation of affected riparians has been overruled. (See E.6.e.)

3) There is nothing in the statute that requires a reallocation of water after another permit is granted.

4) Water uses not covered by s. 30.18 are subject to the common law rule that each riparian owner has the right to make a reasonable beneficial use of the water coming to him or her.

5) Diverting water from a lake that reduces the flow of its outlet stream is a diversion from the outlet stream.

b. Declaratory Rulings

1) A December 31, 1975, order denied a request by Wisconsin Valley Improvement Company for a declaratory ruling to determine which riparians must give consent to use other than surplus water. This denial in effect continued the policy of requiring consent of riparians only to the confluence of the next stream. This policy has since been changed to require that we consider beneficial users to the point where the water leaves the state.

2) A May 12, 1976, declaratory ruling requested by the Plum Lake Golf Course stated that:

a) The chain of title test is an appropriate method to determine riparian status and was recognized by the courts and the legislature.

b) A riparian owner may separate the right to irrigate from the fee title of land. (Subsequent court cases have changed this decision--see Cassidy v. Dept. of Natural Resources, 132 Wis.2d 153 and de Nava v. DNR, 140 Wis.2d 213).

c. Bureau of Legal Services Opinions

A January 9, 1973, memo from Deputy Secretary Andrew C. Damon suggests that the present practice allowing transfer of irrigation permits is acceptable and only requires Department approval.

d. Administrative Policies

1) An internal memo dated January 26, 1973, addressed how the Department would administratively handle several aspects of s. 30.18. Several of the points made are as follows:

a) No permit is required to divert water from a pond or lake that does not have an outlet. If the diversion averages greater than 100,000 gallons per day in any 30 day period, the registration, permit and consultation requirements of 144.026 may now apply.

b) It is presumed that a riparian owner has a right to use water for domestic purposes (watering the lawn or noncommercial gardening) without obtaining a permit under s. 30.18. Such diversions must be of nominal amounts.

c) The amount of water that may be diverted is determined by the tillable acres from each riparian parcel.

2) Memos to the District Directors from Secretary Earl dated July 7, 1976 and Division Administrator George Meyer dated June 8, 1988 explained the emergency procedures to be used during the droughts of 1976 and 1988. (See E.15.)

3) A memo to the District Directors dated June 22, 1977, assigned the authority to approve diversions from trout streams to the District Fish Manager.

4) A memo to the District Directors from Bureau Director Robert Roden dated January 9, 1986, explained new procedures for registration, etc. under ss.30.18 and 144.026.

E. PROCESS

1. APPLICATION

The joint application form (3500-53) should be used with the s. 30.18 informational supplement (3500-60) for irrigation applications, which specifies additional informational requirements. The following information should be submitted before we consider an application complete:

a. The applicant must sign and date the application form. The applicant could be the riparian landowner or the landowner's agent. Under Common Law and the wording of s. 30.18(6), a nonriparian landowner cannot obtain a permit. If the applicant is purchasing the land under land contract, the seller also should sign the application, because the ownership is not transferred until the contract is completed.

b. Applicant's name, mailing address and other information required by the forms.

c. Name of the waterway and the precise location of the proposed diversion.

d. For applications to divert for agriculture or irrigation:

1) Maps showing which parcels of land are to be irrigated and the amount of tillable (arable) land included in each parcel.

2) The annual start-up and ending dates for diversion, the maximum number of acres to be irrigated, the type of crop(s) to be irrigated, the number of applications of water in a dry year, the number of inches of water per application, the maximum rate at which water is to be diverted, and information on the nature of the pumping/irrigating system.

3) An attorney's opinion that shows which portions of the land to be irrigated are riparian to the stream under the chain of title test. A permit can only be issued for the quantity of water needed to irrigate tillable, riparian land, although the water may be used on specified contiguous parcels of land.

e. For applications to divert for maintaining or restoring the level or flow of a lake or stream, a map at a scale of not less than one inch per 2,000 feet showing the topography and the location of the proposed diversion works, along with appropriate plans.

f. For registration to withdraw more than 100,000 gallons per day in any 30-day period:

1) The location of any discharge or return flow.

2) The location and nature of the water use.

3) The actual or estimated average annual and monthly volumes and rates of withdrawal and water loss from the withdrawal.

(See s. 144.026(3) for details on who must register.)

g. For applications to withdraw water that will result in a water loss averaging more than 2,000,000 gallons per day in any 30-day period, see the application requirements and other information in s.144.026(5).

After all the above information is received, a priority date should be assigned to each application. Applicants with an earlier priority date have superior rights over other applicants on the same stream.

2. RIPARIAN STATUS

Until 1957, s.30.18 did not specifically state that a permittee must hold riparian status. However, the 1950 Attorney General's opinion concluded that common law applies (reasonable use by riparians) and that nonriparian use of streams was restricted to navigation and its incidents. The Public Service Commission, therefore, administered the law by requiring riparian status in order to receive a permit.

The two common methods of determining riparian status were the "chain of title" (or "source of title") test and the "unity of title" test. The commission chose the more restrictive chain of title test.

The unity of title test states that all lots or tracts actually touching on a watercourse as well as those contiguous thereto and owned by the same owner are considered riparian.

Under the chain of title test each parcel of land must touch a stream or lake or must be part of a larger parcel, touching a stream or lake, and all of which has come down to the present owner as a unit in an uninterrupted chain of title from the original government patent. See further explanation on the back of the Irrigation Permit Supplement, Form 3550-60.

The Department requires an applicant to provide an attorney's opinion of the riparian status of the various parcels of land using the chain of title test. The field person reviewing the application should send the attorney's opinion to the Water Regulation Section for legal review.

Highways, railroads and other types of roadways may affect the riparian status of a parcel of land. If the right-of-way (ROW) is owned in fee, the portion of the parcel on the landward side of the ROW losses its riparian status unless a condition in the title specifically preserved riparian rights. On the other hand, if the right-of-way exists by way of an easement, the riparian status of the parcel remains intact.

3. CONTIGUOUS LAND

Contiguous lands may be separated from riparian or other contiguous parcels by ROWs owned in fee, without destroying the separated parcel status if the riparian holds an easement of ingress and egress connecting the two parcels.

Prior to 1957, agricultural diverters were not allowed to irrigate contiguous land. The contiguous land amendment of 1957 means that the volume of water withdrawn must be limited to that amount of water necessary to irrigate riparian tillable acreage.

4. TILLABLE ACRES

The amount of tillable riparian land should be calculated based upon existing conditions. The tillable land should be currently under cultivation, should have been used in the past for cultivation or should have the capability to grow crops without major alterations.

Appropriate means to demonstrate tillable acreage are wetland maps, a statement from the local Soil Conservation Service stating that the land is tillable, or aerial photographs showing the land under cultivation. See the back of Form 3500-60.

Once the tillable acres have been determined the annual allowable diversion of water can be established. The amount of water diverted should be no more than one inch per week of growing season unless justified by the soil type and the proposed crop.

5. FIELD INVESTIGATION

Upon receipt of a complete application, a field investigation must be made by Department staff. The investigation should determine whether the proposed diversion will adversely impact public rights in the stream. Establishing a "public rights stage" (minimum water level below which diversion is not allowed) is a major portion of the investigative effort. The public rights stage is the minimum stream stage that will meet the needs of navigation, fish and wildlife, water-based recreation, aesthetic enjoyment, and water quality preservation. The public rights stage is not intended to account for the water needs of downstream riparians.

Stage and flow are directly related. Generally, stage does not increase, in a natural setting without flow also increasing. Normally, an individual flow corresponds to a unique stage. For the remainder of the chapter, flow and stage are sometimes interchanged. For a more detailed explanation of the relationship between stage and flow see Attachment 1.

We determine the public rights stage by following the procedures in the fish management guidelines developed in March of 1977, included as Attachment 1.

Keep several factors in mind when using the guidelines. First, the guidelines state that the public rights stage should be set at the ordinary high-water mark on a stream with a normal summer flow of less than 10 cubic feet per second. This is acceptable only if the investigator can justify such a determination on a factual basis. The smaller the stream, the greater the effect of a particular diversion. A simple reduction in flow by itself may not injure public rights. View the 10 cubic feet per second threshold value specified in the guidelines as an indication of the size of the stream from which diversion may significantly injure public rights and not as a specific cutoff point. There are a number of warm water streams where such a diversion would not cause significant problems.

Second, the public rights stage should be realistic in terms of the normal range of flows experienced on the stream. As a general rule, the aquatic community will be limited by the average annual low flow occurring for a long enough period to produce some substantial effect on the stream ecosystem. The seven-day, two-year low flow ($Q_{7,2}$) should be used to approximate the average annual low flow when gaging information is not available. It is strongly recommended that this low flow figure be considered when a public rights stage is established. Requiring considerably more water to be in the stream than would normally be there under natural late summer conditions may not be a realistic means of controlling a diversion.

In addition to establishing a public rights stage, the field investigation should include a measurement of

flow and stream gradient at the site and an evaluation of the biological communities present. Attach the flow and gradient measurement information to the field report for further processing.

In most cases where water quality is the only public right to be protected, the public rights stage should correspond with the seven-day, ten-year low flow ($Q_{7,10}$).

Specific documentation and rationale for the public rights stage should accompany the field investigation report.

6. SURPLUS WATER DETERMINATION

To determine surplus water, we must first inventory the downstream beneficial users. Under s. 30.18 surplus water is defined as that portion of the flow that is not being beneficially used downstream. The concept of surplus water should not be confused with the public rights stage. With the possible exception of WPDES permittees (waste dischargers), the flow required to protect public rights does not relate to the flow required by downstream beneficial users.

While the various users will all have different nonsurplus water requirements, the flow is not considered surplus until all downstream water needs have been satisfied.

In general, the water requirements of hydroelectric dams will exceed the public rights flow in the stream. The water requirements of downstream irrigators may or may not exceed the public rights flow requirements at the site. The water requirements of waste dischargers generally will be lower than the public rights flow requirements unless the public rights flow has been set at the seven-day, ten-year low flow.

The beneficial users and their water needs which the Department must specifically identify are:

a. Irrigators: The Water Regulation Section has developed and maintains a list of diverters. The list is broken down sequentially by permit number, and diversion sites are shown on county maps. Copies of permits issued in basins extending into more than one district should be sent to the "upstream" district(s) involved for their information and use between revision dates of the list.

b. Power Dams: A list has been developed by the Water Regulation Section and is updated as necessary.

c. Public Water Supplies: A list has been developed by the Public Water Supply Section of the Bureau of Water Supply.

d. WPDES Permittees: A basin/county printout of WPDES permits is provided by the Industrial Wastewater Section of the Bureau of Wastewater Management. Check for further permits since the last update.

e. Other users to be evaluated are:

    1) Industrial diverters.

    2) Commercial downstream recreational boating needs.

    3) Private or commercial hatchery operations.

Because of the virtually unlimited possibilities for beneficial use, the Department should account for and

determine surplus water with respect to all known users downstream from the point of diversion.

Beneficial use by a private landowner generally implies some type of private or commercial use rather than common public use such as boating, swimming or fishing. The public uses should be acknowledged when setting the public rights stage rather than considering them nonsurplus water uses. (See Attachment 1)

The distance downstream to which we must identify beneficial users has not been specifically determined by the court. The Department in the past has used the end of the named streams as the "cut-off point" for recognition of beneficial users. Since the second Omernick v. Department Supreme Court case of 1975, the Department has construed the wording in the decision to mean that we can no longer arbitrarily limit the number of beneficial users. Therefore, all downstream beneficial users within the basin must be identified to the point where the water leaves the state or enters the Great Lakes. The point of use for various purposes is as follows:

- Hydroelectric dam: the location of the powerhouse.
- Diversion: the location of the intake pipe or structure.
- Waste discharge: the location(s) of the outfall(s).
- Public water supply: the location of the intake pipe or structure.
- Commercial downstream recreational use: the launching point plus those reaches of the stream frequently used by customers of the facility.
- Hatcheries: the point of diversion and of any discharge back to the stream.
- A property owner: that portion of the stream that touches the owner's property.

Once we have identified the beneficial users, we must determine their flow requirements. For a hydroelectric dam, the flow requirement at the dam is the maximum quantity of water that can be used by the facility to produce electrical energy. For irrigators, the flow required at the site of their diversion would be the public rights flow at that site plus the allowed diversion rate. For a public water supply, the flow required at the intake is the 7-day, 10-year low flow plus the maximum pump rate of the water utility. For a discharge permit holder, the flow required at the site of the discharge is the 7-day, 10-year low flow unless otherwise specified in their permit (in some cases such as wasteload allocation higher flows may be required).

When we know the flow requirements at the locations of the various users, we must relate these flows upstream to the site of the proposed diversion by some variation of the drainage area proportion method. The nonsurplus water requirements of a downstream user at a proposed upstream diversion site will equal some proportion of the amount required by the user plus a proportion of any consumptive withdrawals between the downstream user and the diversion site. The largest of these values computed from the various nonconsumptive use points will be the nonsurplus water at the diversion site. See Attachment #1 for more detailed discussion of this proportion method.

7. CONSENT TO DIVERT NONSURPLUS WATER

As specified in s.30.18(3)(a)3., diversion of nonsurplus water for irrigation or agriculture can be allowed only when all beneficial users consent to the diversion. Consent must be in writing, usually a letter sent from the user directly to the Department. We also have a sample letter that a user may use to grant consent. (see Chap. 200).

If all necessary consent has been obtained, the application may be processed further by issuing a public notice. If all necessary consent is not obtained, the applicant may request a hearing on the Department's determination of surplus water pursuant to Chapter 227. The only other alternative is for the Department to dismiss the application, unless the applicant agrees to divert only surplus water, with respect to any

beneficial user not consenting to the diversion.

8. ALLOWABLE QUANTITY DETERMINATION

Diversion permits should set limits on the volume of water diverted. Diverting more water than needed ("wasting") is considered an injury to public rights.

A rule of thumb for most crops is one inch of water per week. A greater volume may be justified by the applicant for certain purposes, e.g., golf courses.

The following formula will help:

a. Applicant's requested hours of pumping:

$$\frac{\text{(Acres)(inches of water per application)(number of applications per year)}}{\text{gallons per minute pumped/448.83}}$$

b. Allowable hours:

$$\frac{\text{(1")(\# of weeks per year)(acres)}}{\text{gpm/448.83}}$$

If greater than 1" per week is justified by the applicant, use that figure.

c. To convert hours to gallons:

gpm x 60 x hours

9. NOTICE REQUIREMENTS

Beneficial users should receive a copy of the notice along with any individual who owns lands that will be used for the actual physical diversion. Notices must also be provided to the clerk of the town, village or city and county where the diversion takes place, the clerk of the next town downstream, and the clerk of any adjacent village or city through which the stream runs. Although not required by statutes, it is good practice to notify at least two downstream riparians in the vicinity of the proposal.

The notice should contain some general wording about surplus water. See a sample notice in Chap. 200.

10. OTHER TYPES OF PERMITS

a. Permits to Divert Water to Maintain Lake Levels or Stream Flow

This type of permit is relatively unusual (only about 15 have been granted since 1935). In many ways, processing such a permit is similar to that for the more common agricultural or irrigation diversion.

Major differences are:

1) The diversion may be to bring back or maintain the normal level of a navigable lake or the normal flow of a navigable stream. Higher than normal levels or flows cannot be authorized under this statute.

2) The water may be used in another watershed.

b. Registration to withdraw more than 100,000 gallons per day (0.15 cfs) from surface waters in any 30-day period.

1) Registration isn't required for a person holding a s.30.18 permit who reports the volume and rate of withdrawal (a standard permit requirement) and the volume and rate of water loss. Those reports are normally sent to the water management specialist, who forwards them to the Bureau of Water Regulation and Zoning, which provides them to the Bureau of Water Resources Management.

2) Registrations received by WZ personnel for withdrawals not requiring s.30.18 permits are forwarded directly to the Bureau of Water Resources Management.

3) Registration isn't required for a person holding a WPDES permit, for which the Department has established a water loss coefficient. Wastewater handles these permits.

c. Permits for withdrawals from surface waters resulting in a water loss greater than 2,000,000 gallons per day (3.09 cfs) in any 30-day period.

1) If the withdrawal is from a stream or a lake with an outlet stream, it must meet the standards of both ss.30.18 and 144.026.

2) If the withdrawal is from a lake without an outlet, it must only meet the standards in s.144.026(5). These standards, for application and approval, are considerably more comprehensive than s.30.18 standards. Since we expect to encounter these permits infrequently, the standards are not listed in this handbook.

Registration and permits are also required for appropriate withdrawals from groundwater. These are handled by the Water Supply program.

11. FINAL DISPOSITION

According to s.30.18(15) a permit cannot be issued for diversion of water from a trout stream without the prior written consent of the Department. "Prior written consent" must come from some unit within the Department with expertise in the area of fisheries management and not directly involved in the permit process. The district supervisor for fisheries management should be requested to determine whether or not consent should be given. When we grant a permit to divert water from a trout stream, the permit becomes the "prior written consent." Where consent is not granted, the district fisheries supervisor must send a letter refusing to grant consent, stating the reasons. The denial of consent should state that the applicant has a right to an appeal pursuant to Chapter 227, Wis. Stats.

A permit must contain the findings of fact regarding compliance with procedural requirements, the applicant's riparian status, the applicant's need for the water (a description of the proposed diversion), the establishment of the public rights stage, the Department's determination of surplus water and the required consent from downstream beneficial users, the effect of the proposed diversion on water quality and wetlands, and the completion of any required environmental analysis. A permit typically requires:

- that water only be used on riparian or contiguous land,
- that water only be diverted when the stage in the stream is above the nonsurplus stage,
- that flow metering equipment be installed to enable the Department to better monitor the diversion,
- that the permittee submit a record of water pumped,

- that the permittee install a backflow control device if pesticides are injected into the system, and
- that any activity affecting the quantity of riparian land owned or leased by the permittee be reported to the Department.

A permit expiration date, usually required for a Ch. 30 permit, is not appropriate for a diversion permit unless the diversion is short-term. See sample permit in Chap. 200.

Any person objecting to the decision issuing or denying a permit may seek judicial review by serving and filing a petition in accordance with the provisions of ss. 227.42, 227.52 and 227.53 within thirty (30) days of the decision date.

12. MONITORING OF PERMITS

a. **Monitoring of the public rights stage:** Most permits set a minimum water level below which diversion may not occur. This water level should be related to a benchmark or gage at or near the diversion site. In some cases, a flow at a USGS gaging station or a dam is specified rather than a minimum water level.

The location where the minimum water level has been established should be reasonably accessible to both the applicant and Department personnel. To detect a violation of the public rights stage, the investigator must observe that the water level or flow is below the minimum while the pump is running. In the case where a minimum flow has been specified at a USGS gaging station, the permittee is responsible for determining when diversion is consistent with the permit. Specifying a minimum flow instead of a minimum stage should be used sparingly, since it makes self-monitoring, Department monitoring, and enforcement very difficult. Under this procedure, all parties involved will have a difficult time determining whether or not the permit is being violated. An exception to this case is when telemetering equipment has been installed at the gaging station. This remote reading equipment should allow the irrigator to make routine checks of water levels to assure compliance with the permit. Despite monitoring becoming very difficult, the size of the stream involved may force staff to specify stream flows at gages rather than stages.

b. **Reports by permittees:** Permittees are required to report the dates on which they pumped and the number of hours or gallons of pumping each day. This requirement should be supplemented by readings from the flow meter of the total volume of water diverted before and after each period that the pump has been running.

We must be cautious before using such reports by a permittee to establish a violation. Unless the permittee has been advised of his right to remain silent before he has submitted the report, it would appear that the evidence contained in those reports might not be usable against him. The reports may be better used to form the basis for a revocation proceeding. "First offenders" should be sent a letter advising them that the Department is aware that they are taking more water than their permit entitles them to and that future violations may lead to revocation of the permit and possibly civil forfeitures.

c. **Monitoring the quantity of water diverted:** Where installation of flow metering equipment has been required, monitoring both the diversion rate and the cumulative volume of water diverted only requires direct reading from the flow meter.

At the end of the pumping season, the district person receiving the pumping reports should send an annual summary of gallons pumped per permit per month to the Water Regulation Section.

13. REVIEW OF PERMITS

a. The Department may review any permit. In cases where public rights are not adequately protected from injury by existing permit provisions the permit may be revoked.

b. The 5-year Department review should not be used to adjust permits to the needs of existing beneficial users.

c. Review pursuant to a complaint may require that we revise the public rights stage or flow and may require adjusting the surplus water determination with respect to the complainant. We should hold a hearing to resolve the rights of the various parties.

14. AMENDMENTS, ETC.

Permits may be amended when property is sold, when the permittee requests modifications, when additional restrictions are warranted, or for other reasons. Here are some procedures for certain situations.

a. The permittee sells the property, and the new owner wants to continue the permit. The new owner should submit a written request, a description of the proposed operation (Form 3500-60 provides the needed information), and a copy of the deed. Check against the existing permit. If all is in order, issue a permit transfer.

b. The permittee requests diversion to additional riparian land. Permittee must own the land. A new attorney's opinion may be needed. The permittee may need new or revised consent from downstream beneficial users, depending upon the wording of their consent. If the new land is riparian, if the diversion rate will remain the same, and if the riparian status is verified, issue a permit amendment. If the lands are not riparian, treat as contiguous lands only (no additional water allowed).

c. The permittee requests diversion to additional contiguous land. Permittee may own or lease the land. Attorney's opinion and revised consent are not needed. The total amount of irrigated acres must not exceed the total riparian, tillable acres specified in the permit (or as amended in b. above).

d. The permittee requests an increased diversion rate. Check the status of any consent for diverting nonsurplus water. New consent(s) are required if a specified diversion rate will be exceeded by the new proposal. A substantial rate increase may warrant a new public notice. Check with the Water Regulation Section. If additional land is involved, also check riparian status.

e. The permittee no longer wants the permit. Issue an order rescinding the permit (see Ch. 200).

f. Over time, some permits have been amended many times, leaving a confusing paper trail. We should include all applicable conditions in their permit modifications, so the permittee has one document to follow.

15. ENFORCEMENT

The enforcement of s. 30.18 is very difficult. In addition, restoration obviously is not a viable alternative. This effectively limits formal enforcement to seeking a forfeiture or permit revocation. If an individual is found to repeatedly violate his or her permit provisions, we can presume that he or she would divert any time the water was needed. In such cases, we should consider revoking the permit. A local court would likely be more agreeable to obtaining a forfeiture from an individual diverting without a permit than from an individual who merely violates the terms of the permit.

Section 30.298 lists penalties for violations. Also note s. 30.292 (Parties to a Violation), which may be

helpful for citing the permittee if the violation is committed by an employee, lessee, or person buying the property under land contract.

16. EMERGENCY PROCEDURES

There are no on-going emergency procedures; however, during the 1977 and 1988 droughts, special administrative procedures were implemented to expedite the permit process. Under future drought emergencies we can probably expect similar emergency procedures.

Some examples of special procedures during the emergencies declared by the Governor and/or Legislature:

a. No public notice

b. No consent from downstream beneficial users.

c. No proof of riparian status (attorney's opinion).

d. Expanded definition of contiguous land.

e. Only for agricultural use.

f. Decision within 48 hours of inquiry.

ATTACHMENT 1

A. TERMINOLOGY ASSOCIATED WITH MINIMUM FLOW CRITERIA

1. **$Q_{7,10}$** = the consecutive 7-day low flow that occurs on the average of once in ten years.

   This flow is statistically present or exceeded 97-99% of the time or flow may be at or below this discharge 1-3% of the time in any given year.

   The $Q_{7,10}$ flow is used primarily for establishing water quality parameters for industrial and municipal wastewater dischargers. This flow is usually indicative of drought conditions. Generally, sustained instream flows at this discharge are devastating to instream aquatic habitat and biota.

2. **$Q_{7,2}$** = the consecutive 7-day low flow that occurs on the average of once in two years.

   This flow is statistically present or exceeded 90-93% of the time or flow may be at or below this discharge 7-10% of the time in any given year.

   The $Q_{7,2}$ flow is used in conjunction with certain water quality criteria and was at one time used extensively in establishing minimum flows for irrigators or diversions in large riverine systems.

   Similar to the $Q_{7,10}$ flow, the $Q_{7,2}$ flow has adverse impacts on instream habitat and aquatic biota to the extent of limiting biological diversity and density but usually not to the point of eliminating biological communities.

3. **MINIMUM FLOW** = a designated flow or flow requirement(s) imposed upon water users (i.e., dam owners) that must be released or present at all times to protect the public interest and rights in navigable waters.

   Minimum flow criteria associated with biota usually varies on a seasonal basis depending on certain life stage requirements for aquatic flora and fauna. Habitat and wetted perimeter are key factors governing minimum flow requirements, e.g., spawning habitat for northern pike in a wetland contiguous to a stream or waterfowl habitat adjacent to the waterway.

   Aesthetics and recreation are other parameters influencing minimum flow determinations. For example, the attractiveness of an area associated with the landscape, unique areas of historical or archeological interest or fishing, wading, canoeing, tubing, kayaking, water skiing are all examples of recreational considerations in determining a minimum flow regime.

4. **PUBLIC RIGHTS STAGE** = a designated water surface elevation (sometimes correlated to Q) that restricts any diversion of water from a waterway when the water level is at or below the public rights stage. The "public rights stage" is that water surface elevation that is necessary to protect public rights in a public waterway that could be altered by man-induced actions such as irrigation, etc. This public rights stage is the elevation equivalent to a designated minimum flow.

5. **SURPLUS WATER** = a determination of excess surface water not being beneficially used by downstream riparians or water users. This determination is made primarily for the purpose of protecting the water rights of existing beneficial water users. Beneficial use includes but is not limited to irrigation, hydropower generation, industrial diversion, domestic and municipal water supply and dilution or assimilation of municipal or industrial wastes. Surplus water is associated with the Doctrine of Prior

Appropriations (see Omernick v. DNR). The use of surplus water would not adversely affect an aquatic ecosystem and could therefore be consumed without the detriment to the resource or other existing beneficial water users.

B. PUBLIC RIGHTS STAGE DETERMINATION

We use this determination to find a minimum flow and/or stage to reasonably prevent injury to public rights. The procedure differs between small and large streams but the basic criteria are essentially the same.

1. NON-NAVIGABLE STREAMS

a. The flow or stage selected should be at least that representing the 7-day, 10-year low flow ($Q_{7,10}$).

b. If fishery values exist at the site or if there may be damage to or loss of downstream fish populations in navigable water, the stage or flow selected should preserve the existing aquatic habitat.

c. If the stream contributes a major portion of the flow in downstream navigable waters (this would usually occur where two similar nonnavigable streams join to form navigable water or on a stream just before it becomes navigable), the stage or flow selected should preserve downstream navigability.

2. NAVIGABLE STREAMS

a. The stage or flow selected should at least correspond to the 7-day, 10-year flow ($Q_{7,10}$) (water quality preservation is also a public right to be protected).

b. The stage or flow selected should be adequate to protect fish and aquatic life and aquatic habitat. If stream margin terrestrial habitat depends on water levels, this also should be considered. A rough rule of thumb (the "Montana method") indicates that the minimum flow should be between 30 and 60 percent of the mean annual flow.

c. The stage or flow selected should reasonably protect the stream's navigability.

d. The stage or flow selected should reasonably preserve natural scenic beauty and environmental quality.

In addition to the above general procedure, the investigator should refer to the attached guidelines issued in 1977 by the Bureau of Fish Management. Use the 10 cfs criteria with caution. All public rights stages selected by staff must be rooted in fact and not generalities.

C. RELATION OF PUBLIC RIGHTS FLOW TO DIVERSION

If the public rights flow/stage has been established downstream from the diversion point, that flow or stage must be present in the stream at the designated location while the pump is running. This is the preferred relationship since this directly accounts for the diversion's effect.

If the public rights stage or flow has been established at a point upstream from the diversion site, add the maximum diversion rate to the actual public rights flow and use this larger figure to prevent injury to public rights. Because of the approximations that must be made, this approach is less desirable than having the control point downstream.

The stream flow at the site is important because it allows us to relate the frequency of a particular flow,

which we know or can speculate about, to the frequency of a particular stage, which we know very little about.

If the stream is gaged nearby, it may be possible to use the data at the gage to regulate the diversion.

On large streams where a flow measurement at or near the site is not practicable, a stage of flow will be used to determine the public rights stage. The flow should also be estimated and compared to USGS projected $Q_{7,10}$ and $Q_{7,2}$ values as a check on the stage selected.

A simple method to estimate flow is the floating chip method. Estimate or, if possible, measure the width of the stream. Measure the depth of water above (or below) the stage selected. Estimate the average velocity by floating chip method. The volume of flow above or below the public rights stage is then:

$$Q = AV = (dw)V$$

Where d is average depth, w is width, A is cross-sectional area, and V is the estimated velocity.

D. FISH MANAGEMENT GUIDELINES FOR DETERMINING STREAM "PUBLIC RIGHTS" STAGE

1. INTRODUCTION

The "public rights" stage is the highest minimum stream stage (elevation of the water surface at a point along the stream) resulting from an analysis of the components of the public rights in streams. These components include navigation, fish and wildlife, water-based recreation, aesthetic enjoyment, and preservation of water quality. Various "private" rights exercised by riparian owners (domestic use, industrial use, irrigation or agricultural use and power generation) are accounted for separately in determining the quantity of surplus water available. Municipal and industrial waste dischargers have a dual status because they constitute both a public and a private interest.

These guidelines will be applied by fish managers to intermediate-size streams as a part of the investigation resulting from an application under Section 30.18, Wisconsin Statutes, for authority to divert water for irrigation. The guidelines include a stream classification system, a listing of stream characteristics important to the "fishery management stage" and other "public rights" stages and a procedure for evaluating stream characteristics leading to establishment of a "public rights" stage. Comments about establishment of a navigation and aesthetics "public rights" stage are also included. The objective is to establish the minimum stage necessary to provide food and cover for fish and other aquatic organisms.

2. STREAM CLASSIFICATION

For the purpose of establishing a fishery "public rights" stage, three classes of streams will be used (continuous flow streams only):

a. Streams with 10 cfs or less av. summer flow

(June 1 - September 30). The minimum stage for fishery interests is the ordinary high water mark.

b. Intermediate streams from 10 cfs to 25 cfs av. summer flow

The fishery interest stage is below the ordinary high-water level and must be established by the fish manager.

c. For large streams, over 25 cfs av. summer flow, navigation and water quality public rights factors generally govern.

3. **STREAM CRITERIA**

The criteria to establish this stage must take into consideration the following items:

a. Wetted perimeter - the stream bottom, including the banks that are flowed.

b. Water depth - necessary to provide cover in the pools and maintain food production on the riffles.

c. Stream cover - material or conditions that provide protection, concealment and resting areas in undercut banks; overhanging grasses; shrubs or down trees, instream cover; rocks, boulders or logs; aquatic vegetation; pool depth, and currents that provide concealment by turbulence.

d. Bank stability - water pressure provides stability to prevent slumping in stream banks composed of heavy soils or soils with high water holding capacity. Sudden drawdowns or fluctuations in water level can cause these banks to break down destroying cover.

e. Gradient - the pool riffle ratio.

f. Velocity - provides cover, reaeration and contributes to the variety and abundance of food organisms.

g. Cross sectional area - the living space for aquatic organisms, a function of width and depth at any station.

h. Ordinary high-water mark - the point on the bank or shore up to which the presence and action of the water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation, or other easily recognized characteristics.

All of these items should be considered when establishing the fish management stage. The object is to maintain sufficient water to provide both cover and food, not only at the site but in downstream reaches as well.

E. **PROCEDURE**

1. A general reconnaissance of the stream above and below the site for at least 100 meters or to the controlling riffles if they are present.

2. Establish the ordinary high-water mark on both banks using natural indicators along the bank or thread of the stream, i.e. undercut banks, exposed roots of trees or shrubs, staining of rocks or structures, changes of vegetation types, algae or aquatic organisms.

3. Establish the fish management interest stage - the highest minimum stage that will assure adequate water to provide fish and other aquatic organisms, food and cover.

Adequate bank cover shall be maintained, where it presently exists. In the absence of existing bank cover adequate depth, velocity and instream cover shall be maintained.

Food production areas shall be maintained with adequate depth to provide living conditions for the species represented in the study area.

4. Identify the fish management interest stage by tying it in with the ordinary high-water mark and a temporary benchmark.

5. Establish minimum stage for:
    a. Navigational requirement
    b. Aesthetic requirement

6. Document (highest minimum stage) - public rights stage resulting from above evaluation of fish management, navigation and aesthetics by establishing benchmark reference at appropriate adjacent upland site and reference point (stake in bed or bank, mark on bridge abutment or piling, etc.). Document with photos and survey notes.

F. STREAM GAGING

On streams small enough to gage, a minimum stage can be established and related to flow by Manning's equation. Conversely, if no stage is established, an appropriate minimum flow can be selected and related to the corresponding stage by Manning's equation.

Stream flow may be measured with reasonable accuracy in most cases. Exceptions are areas with highly turbulent flow (rapids, rocky shallows, riffles), areas where the velocity is so low that the inertia of the current meter becomes significant (deep pools, especially sluggish reaches), or at locations with a marked nonuniform flow distribution (bends). Avoid these areas. Also, make sure that the stream bed is firm enough to hold the meter without any significant settlement and that major shifts in the stream bottom will not occur.

The stream is divided into a series of "slices" or sections. These should be of uniform width (generally 1-3 feet, depending on the stream's total width and the uniformity of the channel geometry and velocities), although the last section may be an odd size. Simply stretch a tape across the stream and measure velocities at even increments on the tape. The velocity distribution in a vertical cross-section is such that the maximum usually occurs at about 0.2 of the total depth down form the surface (the surface velocity is reduced to about 95% of the maximum by air resistance). The velocity at 0.6 of the total depth down form the surface is the average velocity in the vertical section (generally 85-90% of the surface velocity).

1. END SECTION METHOD

Measure the velocity across the stream at 0.6 of the measured depth down from the surface (0.4 of the depth up from the bottom) at each incremental point. (The velocity and depth at each bank are usually zero.) Compute the discharge as the sum of the products of the average velocities and the cross-sectional areas of each incremental "slice." For example, the average velocity in the cross-hatched section is

$$V_{AVE} = \frac{V_1 + V_2}{2}$$

The area of the section is approximately

$$A = \frac{W(d_1 + d_2)}{2}$$

The discharge is

$$Q = AV = \frac{W(d_1 + d_2)(V_1 + V_2)}{4}$$

Discharge is computed on Form 3500-2, Stream Discharge Data.

As a general rule, no one section should contain over 10% of the total discharge (this is hard to avoid on small streams). Flows should not be computed to more than one place to the right of the decimal point (the measurements are not accurate enough to warrant any more). Velocities should be recorded to hundredths of a foot per second. The observer should note if the flow is at, above, or below normal, and whether any obstructions are present to influence measurements.

2. **MID-SECTION METHOD**

With the mid-section method, also divide the stream into "slices" or sections of uniform width. Measure velocities at the middle of each section instead of at both ends. Results are similar to those obtained by the end-section method. Compute the discharge as Q = V x W x d.

Situations will arise where one method will provide a more "correct" answer than the other, especially in sections adjacent to the bank. A zero velocity at the bank will favor the end-section method while a bank velocity roughly equal to that at one-half section width from the bank will favor the mid-section method. As long as a reasonable number of velocity measurements are made, computed flows should be comparable.

If site conditions are unusual enough that normal flow measurements are questionable (highly turbulent flow, substantial obstructions or aquatic vegetation, etc.) make independent estimates of flow at nearby culverts or weirs.

The end-section method is recommended for the following reasons:

On small streams where the bank sections carry a higher percentage of the total flow, the end-section method will normally provide better results.

Uniformity within the water management program is highly desirable to increase the interchangeability of data and eliminate potential confusion.

Form 3500-2 is based on the end-section method and is most easily used with it. With the mid-section method, measured depths become mean depths and "mean in vertical" measured velocities must be recorded as "mean in section" velocities. Care must be taken to record the stream width as it does not automatically show up in the last velocity measurement.

Measure velocity at enough points to define the flow distribution. Ten measurements are a bare minimum except in unusually narrow streams. On streams more than ten feet wide, always take more than ten measurements. The following can be used a guide:

Width	No. of Velocity Measurements
Under 10 ft.	10 if possible
10-20 ft.	Minimum of 10
20-60 ft.	Minimum of 20
60-90 ft.	Minimum of 30
Over 90 ft.	One every 3 feet; maximum of 40

To simplify computations, keep the section widths as integral multiples of 0.5 foot. The last section will contain whatever is left below a full increment.

Consider channel geometry and flow distribution when locating measurement points. If the flow is markedly nonuniform, use more sections (smaller intervals) in the high flow portion of the channel. Likewise fewer measurements are needed in low-discharge areas.

The reliability of the measurement is more important than maintaining a uniform interval that is only for convenience of computing flows. Avoid point restrictions such as rocks, clumps of vegetation, small logs, and small scour holes. Adjust the distance between measuring points to bracket such nonrepresentative areas.

It is a good idea to compute stream flow by hand shortly after finishing measurements. This is especially helpful when the public rights stage is being set at the same time. You can compare the measured flow, estimated flow at public rights stage, and known low flow values ($Q_{7,2}$, $Q_{7,10}$) to check the reasonableness of the public rights flow while still in the field.

Once a particular stage and discharge are known a relationship can be developed that defines flows over a variety of stages. This relationship is known as a stage/discharge curve or a rating curve. Standard hydraulic techniques should be used to develop this relationship.

G. BASIN APPROACH AND WATERSHED HYDROLOGY

The basin approach provides an approximate means by which flows at one point in a drainage system can be translated to their equivalent at another location. The need for such a procedure is the relative lack of flow data in Wisconsin, particularly low flows at diversion sites.

Wherever possible, consider using correlation techniques and other data (such as seepage runs along a stream) because the results will be more accurate. If time does not permit, however, we must use more approximate methods.

The basin approach estimates the amount of flow, on a proportional basis, that should pass a given point in the basin to maintain a particular flow at some downstream point on the same tributary or on a main stream (the method does not apply to points on downstream tributaries--it only applies to locations through which the same water will pass). The procedure allows us to estimate corresponding flows between different locations in the basin for different parts of the flow-duration curve. It will be most accurate for nearby points in similar geologic settings and for flows in the middle of the range; the technique becomes less accurate as we include extreme flows and geographical variations in the determination. It is also more approximate as the distance between points increases due to the greater likelihood of differences in precipitation.

1. DETAILED PROCEDURE

The procedure is based on a variation of proportioning flow by drainage area (refer to Figure C-1). Within the gaged subbasins, flows will be based on a proportion from the gaging station in that basin. In other words, at a point Pl in subbasin 1, the flow is

$$Q_{P1} = \frac{Q_{G1} A_{P1}}{A_{G1}}$$

Where Q_{G1} = flow at gaging station G1, A_{P1} = drainage area at point P1, and A_{G1} = drainage area at gaging station G1. For an ungaged stream, the preferred approach is to use a similar gaged stream nearby. For example, at a point P4 in an ungaged basin, the flow could be expressed as

$$Q_{P4} = \frac{Q_{G1} A_{P4}}{A_{G1}}$$

[Figure C-1 appeared here]

These expressions can be simplified by using the term

$$cfsm_l = \frac{Q_{G1}}{A_{G1}}$$

where cfsm is cubic feet per second per square mile of drainage area. For areas where nearby gaged tributaries are not likely to be representative, a more complex technique is called for.

We may represent the flow at the basin outlet or exit point as

$$Q_{Gt} = Q_l + Q_2 + Q_3 + Q_{\text{ungaged area}} = A_{Gt}\,(cfsmG_t)$$

where $Q_1 = A_1(cfsmG_1)$ = flow at outlet of basin Bl

$Q_2 = A_2(cfsm_{G2})$ = flow at outlet of basin B2

$Q_3 = A_3(cfsm_{G3})$ = flow at outlet of basin B3

$$Q_{ungaged} = A_{ungaged}\,(cfsm_{ungaged})$$

In the expression for Q_{Gt}, everything is known except $cfsm_{ungaged}$ because

$$A_{Gt} = A_1 + A_2 + A_3 + A_{ungaged}$$

and $A_{ungaged}$ can thus be computed. Therefore, $cfsm_{ungaged}$ can be computed. We can then compute for other points in the system in the following manner:

$$Q_{P2} = A_1(cfsm_{Gl}) + A_2(cfsm_{G2}) + (A_{P2} - A_1 - A_2)(cfsm_{ungaged})$$

$$Q_{P3} = A_1(cfsm_{Gl}) + A_2(cfsm_{G2}) + (A_{P3} - A_1 - A_2 - A_3)(cfsm_{ungaged})$$

As a variation, if we consider the subbasin where point P4 is located to be similar to the subbasin where gaging station G1 is located, the flow at point P2 can be calculated as

$$Q_{P2} = (A_1 + A_4)(cfsm_{g1}) + A_2(cfsm_{G2}) + (A_{p2} - A_1 - A_2 - A_4)(cfsm_{ungaged})$$

This approach takes into account the variability of individual subbasins to the extent possible while still using a basic drainage area proportion technique. A more accurate approach would be to develop a basin hydrologic model using correlation and flow routing techniques. Such a model may be available in limited instances, but is generally too time consuming and costly.

The basin approach can be used to transfer mean annual flows, mean annual low flows, or 7-day, 10-year low flows from one point to another. It must be recognized that while a transfer of mean annual flows may be relatively accurate, transfer of low flows is more approximate because of the greater potential for variation in the factors that control low flows.

Another example of using this technique is in proportioning downstream user requirements to an

upstream site. If P_2 is a proposed diversion site and the downstream user is a hydrodam located at P_3, the following steps will approximately proportion the flow:

a. Estimate stream flow at point P_2 based on downstream gage, G_t

$$Q_{P2} = A_1 (cfsm_{Gl}) + A_2(cfsm_{G2}) + (A_{P2} - A_1 - {}_{A2})(cfsm_{ungaged})$$

b. Similarly estimate flow at point P3

$$Q_{P3} = A_1(cfsm_{G1}) + A_2(cfsm_{G2}) + A_3(cfsm_{G3}) + (A_{P3} - A_1 - A_2 - A_3)(cfsm_{ungaged})$$

We can relate the downstream user flow at point P_3, Q_{UP3} to the estimated natural flow Q_{P3} by a ratio and the flow at point P_2, Q_{UP2} needed to sustain the downstream user is then

$$Q_{UP2} = \frac{Q_{P2}(Q_{UP3})}{Q_{P3}}$$

It should be recognized that this is <u>not</u> a straight drainage area proportion because we have accounted for the variability of subbasins. We can use the same technique to estimate upstream flow requirements for any downstream beneficial user whose flow requirement is known. Perhaps the most laborious part of this computation is to determine drainage areas at a specific site. Sometimes these can be found in or closely approximated from the U.S. Geological Survey (USGS) publication, "Drainage-Area Data for Wisconsin Streams." In other cases, it may be necessary to planimeter areas from topographic maps upon which the watershed boundaries have been determined and outlined.

If the point in question is on the main stream below the most downstream gage (e.g. the Chippewa River below Durand, the Wisconsin River below Muscoda, the Fox River below Rapids Croche Dam), we can estimate the flow as

$$Q_{POINT} = A_{POINT}(cfsm_{Gt})$$

2. APPROXIMATE PROCEDURE

In many cases, we cannot use the detailed procedure due to time constraints or general lack of data. We then use a more approximate technique to transfer flows within a drainage basin.

The technique is most appropriate on streams where USGS gaging stations are located. The basis for the technique is the variation of average flows between different gaging stations. The indicator used is the "cfsm" for each respective station (the average flow for the period of record divided by the drainage area at the station). This indicator typically will change from station to station within a drainage basin and reflects the variation in flow contributions between tributaries and points on the main stem on an average basis. In unusual circumstances, we can use a flow other than the average to develop the cfsm ratio ($Q_{7,2}$ could be used, as an example), but extreme high or low flows should be avoided. Whatever flow type is selected, the same must be used for all other stations in the analysis. As an example, cfsm ratios are calculated for various stations within the Chippewa River basin using USGS flow data for 1976.

Station	Period of Record Average Flow (cfs)	Drainage Area (sq. mi.)	cfsm
Chippewa River near Winter	716	787	0.910
Chippewa River near Bruce	1460	1630	0.896
Chippewa River at Chippewa Falls	5110	5600	0.912

Chippewa River at Durand	7524	9010	0.835
Red Cedar R. near Cameron	399	453	0.881
Red Cedar R. near Colfax	754	1100	0.685
Red Cedar R. at Menononie	1243	1760	0.706
Flambeau River near Bruce	1839	1900	0.968
Jump River at Sheldon	514	574	0.895
Hay River at Wheeler	294	426	0.690

To use this method, there must be a cfsm figure that applies to the proposed diversion site (if there is none, either the detailed procedure or the unweighted drainage area ratio method must be used). For any downstream user lacking a cfsm figure (this is very unlikely to occur where there is a cfsm at the proposed diversion site), an unweighted drainage area ratio must be used.

3. UNWEIGHTED DRAINAGE AREA RATIO

In cases where data is very sparse or greater accuracy is not needed, assume the flow to be directly proportional to drainage area at any particular site. This assumption is rather crude since it does not account for the various factors other than drainage area (such as geology, soils, vegetative cover, topography, precipitation, etc.) that affect stream flow. In those cases where approximations are acceptable, this method provides a "ball park" answer with a minimum of effort.

4. EXAMPLES

A series of examples will be used to show how to transfer the requirements of a downstream user to an upstream diversion site using the various methods. The applicant is a hypothetical irrigator on the Chippewa River in Rusk County. The user is the Holcombe Dam on the Chippewa River, owned by Northern States Power Company. The basic data is shown on Figure C-2.

a. Detailed Procedure

$Q_t = Q_1 + Q_2 + Q_3 + Q_{ungaged}$

$Q_{ungaged} = A_{ungaged}(cfsm_{ungaged})$

$5110 = 1460 + 1839 + 514 + A_{ungaged}(cfsm_{ungaged})$

$A_{ungaged} = 5600 - (1630 + 1900 + 574) = 1496$ sq. mi.

[Figure C-2 Appears Here]

1297 = 1496 ($cfsm_{ungaged}$)

$cfsm_{ungaged} = 0.867$

Average flow @ Holcombe

$Q_{ave} = 1460 + 1839 + 514 + 4700 - (1630 + 1900 + 574)(0.867)$

$= 3813 + (596)(0.867) = 4330$ cfs

Average flow @ diversion site

$Q_{ave} = 1460 + 1839 + 3800 - (1630 + 1900)(0.867)$

$= 3299 + 270 (0.867)$

$= 3533$ cfs

User requirement for Holcombe Dam transferred to the diversion site then is

$$Q_{req'd} \text{ @ site} = \frac{(3533)(12{,}300)}{4330} = 10{,}036 \text{ cfs}$$

b. CFSM Procedure

Once a cfsm figure has been determined for each site, we apply the ratio of these to the user flow requirement.

The cfsm figures are only applied to the same named stream as the respective gaging stations. In other words, a cfsm figure from a main stream gaging station would not be applied to an ungaged tributary. Also, when more than one gaging station is located on the same stream, the cfsm figure is assumed to vary linearly with drainage area between the stations.

Since both the applicant and the user are located on the Chippewa River, we use the closest gaging stations on that stream.

For the Holcombe Dam:

cfsm near Bruce = 0.896 (D.A. = 1630 sq. mi.)
cfsm @ Holcombe = ? (D.A. = 4700 sq. mi.)
cfsm @ Chippewa Falls = 0.912 (D.A. 5600 sq. mi.)

$$\text{Thus, cfsm @ Holcombe} = 0.896 + \frac{(4700 - 1630)}{(5600 - 1630)}(0.912 - 0.896)$$

$= 0.908$

For the applicant:

cfsm near Bruce = 0.896 (D.A. = 1630 sq. mi.)
cfsm @ applicant = ? (D.A. = 3800 sq. mi.)
cfsm @ Chippewa Falls = 0.912 (D.A. = 5600 sq. mi.)

Thus, cfsm @ applicant = $0.896 + \frac{(3800 - 1630)}{(5600 - 1630)} (0.912 - 0.896)$

= 0.905

Average flow @ Holcombe = $\frac{(0.908) (4700)}{(0.896) (1630) (5110)}$

= 4266 cfs

or

Average flow @ Holcombe = $\frac{(0.908) (4700) (5110)}{(0.912) (5600)}$

= 4270 cfs

and

Average flow @ applicant = $\frac{(0.905) (3800) (1460)}{(0.896) (1630)}$

= 3438 cfs

or

Average flow @ applicant = $\frac{(0.905) (3800) (5110)}{(0.912) (5600)}$

= 3441 cfs

User requirement for Holcombe Dam @ proposed diversion site then is

$Q_{req'd}$ @ site = $\frac{(0.905) (3800) (12,300)}{(0.908) (4700)}$ = 9912 cfs

Note that we may compute the average flow by using either the upstream or the downstream gage (the figures are essentially the same).

c. Unweighted Drainage Area Ratio

Average flow @ Holcombe = $\frac{(4700)\ (1460)}{(1630)}$

= 4210 cfs

or

Average flow @ Holcombe = $\frac{(4700)\ (5110)}{(5600)}$

= 4289 cfs

Average flow @ applicant = $\frac{(3800)\ (1460)}{(1630)}$

= 3404 cfs

or

Average flow @ applicant = $\frac{(3800)\ (5110)}{(5600)}$

= 3468 cfs

Flow requirement for Holcombe Dam @ diversion site

= $\frac{(3800)\ (12,300)}{(4700)}$

= 9945 cfs

d. Comparison of Results

	Ave. Flow @ Holcombe	Ave. Flow @ Diversion	User Flow @ Diversion
Detailed Method	4330	3533	10,036
CFSM Method	4270	3440	9,912
Unweighted Method	4250	3435	9,945

In this case, little difference is noted between methods. There are several reasons for this:

1) There is little variation in cfsm figures between gaging stations.

2) All cfsm values are close to 1.0

3) The evaluated sites chosen are near each other and are on the same stream with only one intervening tributary (the Jump River).

These conditions will not exist in most cases, so we must be careful in choosing the method. In

general, we should use the cfsm method when there is a cfsm value for the proposed diversion site.

5. LOW FLOW HYDROLOGY

We frequently need to estimate the $Q_{7,2}$ and $Q_{7,10}$ flows at a diversion site. Several USGS publications are available to provide estimates for a variety of locations in Wisconsin. When using these publications, take care to use the most up-to-date figures. It may be a good idea to contact USGS directly to obtain this data.

a. Available Data

The following publications contain low flow information:

1) "Low-Flow Frequency of Wisconsin Streams" by Warren A. Gebert, U.S. Geological Survey Hydrologic Investigations Atlas HA-390; 1971. This publication consists of a map of Wisconsin showing low flow figures at various gaging stations. Many of the estimates on the map are outdated.

2) "Low-Flow Characteristics of Wisconsin Stream at Sewage-Treatment Plants" by W. A. Gebert and B. K. Holmstrom, U.S. Geological Survey Water Resources Investigations 45-74; 1974. This publication contains a number of low flow figures at various sites in Wisconsin and is organized by drainage basin. Most figures in this publication are still reliable.

3) "Preliminary Estimates of Low-Flow Characteristics of Wisconsin Streams at Sewage Treatment Plants and Industrial Plants" by B. K. Holmstrom, U.S. Geological Survey Administrative Report; 1977. This report contains up-to-date low flow information at a variety of sites and is organized by drainage basin.

4) U.S. Geological Survey Hydrologic Investigations Atlases for various river basins in the state.

5) U.S. Geological Survey Open-File Reports

In some cases, the hydrology of a particular stream is covered in a U.S.G.S. report. An example of such a report is "Low-Flow Characteristics of Eau Claire River Basin Near Antigo, Wisconsin," that contains low-flow estimates at and near several existing and proposed diversion sites.

6) U.S.G.S. Low-Flow Basin Studies

The U.S.G.S. developed a series of reports on low flows in most basins around the state. The reports contain equations that can be used to estimate both $Q_{7,2}$ and $Q_{7,10}$ at any site in the basin. Better results are obtained at sites where at least one base flow measurement has been made.

7) USGS may be able to provide low flow estimates over the phone for basins without published data.

b. Examples of Low-Flow Estimation

Three common situations are found in low flow estimation. Each is discussed in turn and an example of estimating flow is provided.

1) More than one low flow estimate on the stream: This is typical for larger streams. First, plot the $Q_{7,2}$ and $Q_{7,10}$ values against drainage area on log-log paper. We can use the best straight line through the $Q_{7,2}$ points to estimate $Q_{7,2}$ at any other location with a known drainage area. Where there is any significant scatter so that one straight line does not come close to all of the points, it is better to simply connect successive points by straight lines. The broken line, consisting of the various segments, is than used to estimate low flows. The same procedure applies for $Q_{7,10}$. Plotted points may be from stations on the main stream only or may include stations on major tributaries. For example, a curve can be developed for the Embarrass River and its major tributaries. The data is as follows:

Stream	Drainage Area (Sq. Mi.)	$Q_{7,2(cfs)}$	$Q_{7,10(cfs)}$	Source*
Embarrass River, South Branch	27	5.6	3.4	1
Embarrass River, South Branch	94.8	23	14	2
Embarrass River, North Branch	39.5	9.8	6.0	2

Stream	Drainage Area (Sq. Mi.)	$Q_{7,2(cfs)}$	$Q_{7,10(cfs)}$	Source*
Embarrass River	265	54	33	2
Embarrass River	395	75	45	1

* Sources (1) H.A. - 390
(2) WRI 45-74

The lines on this graph would essentially pass through all of the points. This is not always true. Care should also be taken in extrapolating the curves (estimating flows for drainage area less than or larger than those for all of the data points).

2) One flow estimate on a stream: In this situation, use a drainage area proportion from the known site, weighted, if necessary, by the generalized low-flow runoff values from the basin hydrologic atlases (references 4a-l).

For example, estimate the low flow on Duncan Creek (Chippewa County) at a location near New Auburn (D.A. = 15 sq. mi.). From WRI 45-74, $Q_{7,2}$ = 10.5 cfs and $Q_{7,10}$ = 6.7 cfs for D.A. = 49.2 sq. mi. From H.A. 386, low flow runoff = 0.51 cfs/sq. mi. at the low flow station and = 0.41 cfs/sq. mi. at the proposed diversion site. Soil permeabilities are roughly similar. Thus the low flows at the site are:

$Q_{7,2} = \frac{10.5\ (15)\ (0.41)}{(49.2)\ (0.51)} = 2.6$ cfs

$Q_{7,10} = \frac{6.7\ (15)\ (0.41)}{(49.2)\ (0.51)} = 1.6$ cfs

3) No low flow measurements on the stream. Two procedures are available here:

a) Use of basin low flow curve.

One method for tributary streams is to assume that the low flow curve for the main stream applies to the tributary. For example, determine the low flow on Moose Ear Creek in Barron County (tributary to Chetek and Red Cedar Rivers).

D.A. @ site = 39 sq. mi.; from Red Cedar River low flow curve.

$Q_{7,2} = 3.1$ cfs

$Q_{7,10} = 1.9$ cfs

b) Use of basin transfer methods.

A second method is to find a similar nearby stream and relate its low flows to the stream in question with appropriate weighting from the generalized low flow runoff shown on the basin hydrological atlas. Again, the example will be Moose Ear Creek, Barron County. A nearby stream is Rock Creek, where, according to HA 390, $Q_{7,2} = 7.3$ cfs and $Q_{7,10} = 3.1$ cfs for a drainage area of 41 square miles. According to the "Surface Water Resources of Barron County," both streams begin as trout streams in the Blue Hills area, both have relatively steep gradients (15 ft/mile for Moose Ear Creek and 21 ft/mile for Rock Creek), and both are 11-12 miles long. The Chetek topographic map shows similar forest cover in both watersheds. HA 386 shows similar soil permeabilities and low flow runoff characteristics. The low flows on Rock Creek can thus be used to estimate those on Moose Ear Creek. At the site,

$Q_{7,2} = \frac{7.3\ (39)\ (0.3)}{(41)\ (0.33)} = 6.3$ cfs

$Q_{7,10} = \frac{3.1\ (39)\ (0.3)}{(41)\ (0.33)} = 2.7$ cfs

c) Comparison

The two estimates do not agree very well in this case. The suggested procedure is to average the two estimates. In this case, the USGS has estimated the low flows at:

$Q_{7,2} = 4.1$ cfs; $Q_{7,10} = 2.1$ cfs

The average of our two estimates is:

$Q_{7,2} = 4.7$ cfs; $Q_{7,10} = 2.3$ cfs

c. Additional Comments

It should be recognized that low flows cannot be as readily transferred from site to site, particularly between drainage basins, as can average flows. This is true because the factors affecting low flow (bedrock geology, soil permeability, forest cover, etc.) often vary more between adjacent watersheds than those affecting average flows (precipitation, general topography, general soil condition, etc.)

Separate low flow estimates are not required for various downstream user locations (WPDES permittees, public water supplies) as well as for the diversion site. Instead, the low flow values at the diversion site are presumed to satisfy low flow needs downstream.

CORRESPONDENCE/ MEMORANDUM **STATE OF WISCONSIN**

DATE: March 14, 1997 FILE REF: Chapter 90, Water Regulation Guidebook

DISTRIBUTION: Water Regulation Field Staff
Rivers and Regulations Section Staff

TO: Regional Directors

FROM: Mary Ellen Vollbrecht
Rivers and Regulations Section, FH/3

SUBJECT: Program Guidance on s. 30.18 Permits

This guidance provides specific instructions to carry out the 1995 Water Regulation and Zoning Program Management Team decision to stop requiring monthly pumping reports from surface water diverters (mainly agricultural irrigators). Pumping reports measure the amount of water taken from surface waters. The data is important to analyzing the resource impacts of diversion and other activities, but is not analyzed on an ongoing basis.

1. If you haven't already done so, notify diverters in writing that they no longer need to report, but that they are responsible for keeping their own records and providing them to us on request. That way, we can get the information when we need it. Failure to keep the records is a violation of the permits. If we amend the permits in the future, we can modify the record keeping requirement.

Staff may still ask for the monthly reports if staff decides it wants them, but notify the applicant of how we intend to use the data.

We should also remind the diverters to advise us of address changes and that a new owner must obtain a permit transfer if the property is sold.

Dale Lang prepared a sample notification letter which your staff can use or modify. A copy is attached. It's also on the WZDATA file service as PUMP.LET.

2. For diverters who have an agreement with Wisconsin Valley Improvement Company, letters should include a statement that they must report annually to WVIC, and give them a couple of our annual pumping record sheets with which to do it. If they fail to report, WVIC can rescind the agreement and take whatever action it desires to recover damages.

3. New permittees should still install flow meters so they have some way to keep records and we can verify the amount pumped. New permits should change the record reporting condition to state "submit the record to the DNR upon requester

4. In following years, the Rivers and Regulations Section will send an annual letter to all permittees reminding them of the requirements. Therefore, field staff should send the section a list of the current names and addresses along with the permit numbers, after sending out this year's letter. The list needs to identify WVIC diverters and diverters from whom monthly reports are required. Staff should then send copies of future name and address changes to the section (FH/4).

Prepared by
Dale Lang

Reviewed by
Ed Bourget
Dick Koch
Bob Hansis

This annual letter to surface water irrigation permittees announces some significant changes to our procedures. Please read this carefully so you understand what is required in the future.

1. The Department no longer requires you to submit pumping reports to us. However, it is still necessary for you to keep your own records. From time to time we may ask you for the records when we are doing water use planning in your area, responding to complaints, or monitoring water consumption. Your permit requires you to maintain the records. If you don't have the records, you will violate your permit.

   If your permit requires you to have a flow meter, you must maintain it so you can keep records and we can verify the amount pumped.

2. You must notify us of any address changes. Please send them to my office.

3. If you sell the property to another party who wants to continue irrigating from the waterway, the new owner must apply for a permit transfer. Please have the new owner contact me. If the new owner does not plan to irrigate, we will cancel the permit.

4. (OPTIONAL) If you are in the Wisconsin River basin and have an agreement with Wisconsin Valley Improvement Company, you must send an annual pumping report to WVIC. The address is:

   2301 North Third St, Wausau WI 54403-3299

   This is required so WVIC will know how much you pump and can bill you for the water you use. If you don't send WVIC your report, the company could revoke your agreement and possibly take legal action to recover the water use cost or even prevent you from using your permit. Be sure to keep a copy of the record you send to WVIC so you can show it to us when needed.

5. The Rivers and Regulations Section at our central office in Madison will periodically send you a letter to remind you of the requirements.

I'm enclosing several of our annual pumping report forms for you to use. Feel free to make copies of them in the future, or contact me if you need more. Remember -- don't mail them to us unless we ask you to send them.

Please contact me if you have any questions.
Sincerely,
lang\pump.l